

WHAT IS CLAIMED IS:

1. A method comprising:

5 sending a first message from a first party to a second party via a first policy enforcement device, said first message carrying a resource reservation request for communication from said first party to said second party, said first policy enforcement device connecting to a network;

10 sending a second message from said second party to said first party via a second policy enforcement device, said second message acknowledging the first message, said second message carrying a resource reservation request for communication from said second party to said first party, said second policy enforcement device connecting to a network; and

15 sending a third message from said first party to said second party, said third message acknowledging said second message.

2. The method of claim 1, wherein

said first message includes a PATH message;

said second message includes an RESV message;

said third message includes an RESV confirmation message;

said policy enforcement device includes an edge router;

20 said policy enforcement device includes a multiplexer;

said first party is the initiating party between two participants in a two-way communication; and

said second party is the non-initiating party of the two participants in said two-way communication.

3. The method of claim 1, further comprising:

reserving a first resource needed for the communication from said first party to

5 said second party according to the resource reservation request carried in said first message;
and

probing a network path between said first party and said second party, said network path being defined by at least one policy enforcement device address and stored in said first message, said first message traveling along said network path.

10 4. The method of claim 1, further comprising:

reserving a second resource needed for the communication from said second party to said first party according to the resource reservation request carried in said second message.

5. A method for a first party initiating a two-way communication, comprising:

15 constructing a PATH message, said PATH message carrying a resource reservation request;

sending said PATH message to a policy enforcement device, said policy enforcement device connecting to a network;

20 receiving a message from said policy enforcement device, said message being either a PATH_ERR message or an RESV message, said message resulting from said sending of the PATH message;

sending an RESV_Confirm message to said edge policy enforcement device if said message is an RESV message; and

aborting the initiating of said communication if said message is a PATH_ERR message.

6. A method for an ingress policy enforcement device, said ingress being defined in the direction from a first party to a second party, said first party initiating a two-way communication, said ingress policy enforcement device connecting to a network, said method comprising:

intercepting a PATH message, said PATH message carrying a resource reservation request;

reserving needed network resource according to the resource reservation request carried in said PATH message, said reserving yielding a decision or either positive, representing granting the needed network resources, or negative, representing not granting the needed network resources;

forwarding said PATH message to an egress policy enforcement device if said decision is positive, said egress policy enforcement device connecting to the same network as said ingress policy enforcement device; and

sending a PATH_ERR message to said first party if said decision is negative.

7. A method for an egress policy enforcement device, said egress being defined in the direction from a first party to a second party, said first party initiating a two-way communication, said egress policy enforcement device connecting to a network, said method comprising:

intercepting a message, said message being either a PATH message or an RESV message, said PATH message carrying a resource reservation request for communication from said first party to said second party, said RESV message carrying path

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information and a resource reservation request for communication from said second party to said first party;

adding an address to said PATH message if said message is a PATH message, said address identifying said egress policy enforcement device, said adding resulting in a revised PATH message;

determining a forwarding address for forwarding said revised PATH message;
forwarding said revised PATH message to said forwarding address;
reserving needed network resource if said message is an RESV message, said needed network resource being specified by the resource reservation request carried in said RESV message, said reserving yielding a decision of either positive, representing granting the needed network resource, or negative, representing not granting the needed network resource;

determining a next hop address if said decision is positive, said next hop address being determined from the path information carried in said RESV message;

forwarding said RESV message to said next hop address; and
sending an RESV_ERR message to said second party if said decision is negative.

8. A method for a second party being the non-initiating party between two participants in a two-way communication, comprising:

intercepting a PATH message;
sending an RESV message to a policy enforcement device as a response to the PATH message intercepted by said intercepting, said RESV message carrying path

information and a resource reservation request, said policy enforcement device connecting to a network;

receiving a message, said message resulting from said sending of said RESV message, said message being either a RESV_ERR message or a RESV_Confirm message;

5 entering a two-way communication session if said message is said RESV_Confirm message; and

aborting the initiation of said communication if said message is an RESV_ERR message.

9. A method comprising:

10 sending a first message from a first party to a second party via a first policy enforcement device, said first policy enforcement device connecting to a network;

sending a second message from said second party to said first party via a second policy enforcement device, said second message acknowledging the first message, said second message carrying a resource reservation request for the communication from said first party to said second party, said second policy enforcement device connecting to a network;

20 sending a third message from said first party to said second party via a third policy enforcement device, said third message acknowledging said second message, said third message carrying a resource reservation request for the communication from said second party to said first party, said third policy enforcement device connecting to a network; and

sending a fourth message from said second party to said first party, said fourth message acknowledging said third message.

10. The method of claim 9, wherein

said first message includes a PATH message;
said second message includes an RESV+PATH message;
said third message includes an RESV_Confirm+RESV message;
said fourth message includes an RESV_Confirm message;
5 said policy enforcement device includes an edge router;
said policy enforcement device includes a multiplexer;
said first party initiates a two-way communication with at least one said second party; and

said second party is an non-initiating party in said two-way communication.

10 11. The method of claim 9, further comprising:

probing a network path between said first party and said second party, said network path being defined by at least one policy enforcement device address and being stored in said first message.

12. The method of claim 9, further comprising:

15 reserving a first resource needed for the communication from said first party to said second party according to the resource reservation request carried in said second message; and

probing a network path between said second party and said first party, said network path being defined by at least one policy enforcement device address and being
20 stored in said second message.

13. The method of claim 9, further comprising:

reserving a second resource needed for the communication from said second party to said first party according to the resource reservation request carried in said third message.

14. A method for a first party initiating a two-way communication, comprising:

- 5 constructing a PATH message;
- sending said PATH message to a policy enforcement device, said policy enforcement device connecting to a network;
- receiving a first message from said policy enforcement device, said first message being a RESV+PATH message, said first message resulting from said sending of
- 10 said PATH message;
- aborting the initiating of said communication if said first message is an RESV_ERR message;
- sending an RESV_Confirm+RESV message to said policy enforcement device if said first message is an RESV+PATH message;
- 15 receiving a second message from said policy enforcement device, said second message being either an RESV_ERR message or an RESV_Confirm message, said second message resulting from said sending of an RESV_Confirm+RESV message; and
- entering a two-way communication session as a response to said second message.

- 20 15. A method for an ingress policy enforcement device, said ingress being defined in the direction from a first party to a second party, said first party initiating a two-way communication, said ingress policy enforcement device connecting to a network, said method comprising:

intercepting a message, said message being either a PATH message or an RESV+PATH message, said RESV+PATH message carrying both path information and a resource reservation request for the communication from said first party to said second party;

adding an address to said PATH message if said message is a PATH message,

5 said address identifying said ingress policy enforcement device, said adding resulting in a revised PATH message;

determining a forwarding address for forwarding said revised PATH message;

forwarding said revised PATH message to said forwarding address;

10 reserving needed network resource if said message is an RESV+PATH message, said needed network resource being specified by the resource reservation request carried in said RESV+PATH message, said reserving yielding a decision of either positive, representing granting the needed network resource, or negative, representing not granting the needed network resource;

15 determining a next hop address if said decision is positive, said next hop address being determined from the path information carried in said RESV+PATH message;

forwarding said RESV+PATH message to said next hop address; and

sending an RESV_ERR message to said second party if said decision is negative.

16. A method for an egress policy enforcement device, said egress being defined in
20 the direction from a first party to a second party, said first party initiating a two-way communication, said egress policy enforcement device connecting to a network, said method comprising:

intercepting a message, said message being a PATH message, an
RESV+PATH message, or an RESV_Confirm+RESV message, said RESV+PATH carrying
path information and a resource reservation request for the communication from said first
party to said second party, said RESV_Confirm+RESV carrying path information and a
5 resource reservation request for the communication from said second party to said first party;

adding an address to said PATH message if said message is a PATH message,
said address identifying said egress policy enforcement device, said adding an address
resulting in a revised PATH message;

determining a hop address for forwarding said revised PATH message;

10 forwarding said revised PATH message to said hop address;

adding said address to said RESV+PATH message if said message is an
RESV+PATH message, said adding said resulting in a revised RESV+PATH message;

determining a next hop address for forwarding said revised RESV+PATH
message, said next hop address being determined from the path information carried in said
15 RESV+PATH message;

forwarding said revised RESV+PATH message to said next hop address;

reserving needed network resource if said message is an
RESV_Confirm+RESV message, said needed network resources being specified by the
resource reservation request carried in said RESV_Confirm+RESV message, said reserving
20 yielding a decision of either positive, representing granting the needed network resource, or
negative, representing not granting the needed network resource;

determining a next hop address if said decision is positive, said next hop address being determined from the path information carried in said RESV_Confirm+RESV message;

forwarding said RESV_Confirm+RESV message to said next hop address; and

5 sending an RESV_ERR message to said first party if said decision is negative.

17. A method for a second party, said second party being the non-initiating party of the two participants in a two-way communication, said method comprising:

intercepting a PATH message;

10 sending an RESV+PATH message to a policy enforcement device as a response to said PATH message intercepted by said intercepting, said RESV+PATH message carrying path information and a resource reservation request for the communication from said first party to said second party, said policy enforcement device connecting to a network;

15 receiving a message, said message being either an RESV_ERR message or an RESV_Confirm+RESV message, said message resulting from said sending of an RESV+PATH message;

sending an RESV_Confirm message to a first party if said message is an RESV_Confirm_RESV message, said first party being the initiating party in said two-way communication; and

20 entering a two-way communication session after said sending of an RESV_Confirm message.

18. A system comprising:

a sender to initiate a two-way communication by sending a first message, said first message carrying a resource reservation request for the communication in a forward

direction initiated from said sender, said sender receiving a second message carrying path information and a resource reservation request for the communication in a reverse direction ending at said sender, said sender responding to the second message by sending a third message before said two-way communication session starts;

5 at least one ingress policy enforcement device, where ingress is defined according to said forward direction, said at least one ingress policy enforcement device receiving said first message sent by said sender and reserving needed network resource according to the resource reservation request carried in said first message, said at least one ingress policy enforcement device forwarding said first message if the requested network
10 resources are granted;

 at least one egress policy enforcement device, where egress is defined according to the forward direction, said at least one egress policy enforcement device receiving both the first message sent by said sender via one of said at least one ingress policy enforcement device and the second message, adding its own address to said first message
15 before forwarding the first message, reserving needed network resource according to the resource reservation request carried in said second message before forwarding the second message, and forwarding the second message according to the path information carried in said second message if the network resources requested by said requesting are granted; and

 a receiver, said receiver being the non-initiating party in said two-way
20 communication, said receiver receiving said first message sent by said sender, responding the first message by sending said second message to the sender, said second message being sent via one of said at least one egress policy enforcement device connecting the receiver and a

network, the receiver entering said two-way communication session after receiving said third message sent directly from the sender.

19. An apparatus for a sender initiating a two-way communication, comprising:

means for constructing a PATH message, said PATH message carrying a
5 resource reservation request;

means for sending said PATH message to a policy enforcement device, said
policy enforcement device connecting to a network;

means for receiving a message from said policy enforcement device, said
message being either a PATH_ERR message or an RESV message, said message resulting
10 from said sending of the PATH message;

means for sending an RESV_Confirm message to said policy enforcement
device if said message is an RESV message; and

means for aborting the initiating of said communication if said message is a
PATH_ERR message.

20. An apparatus for an ingress policy enforcement device, said ingress being defined
in the direction from a sender to a receiver, said sender initiating a two-way communication,
said ingress policy enforcement device connecting to a network, comprising:

means for intercepting a PATH message, said PATH message carrying a
resource reservation request;

20 means for reserving needed network resource according to the resource
reservation request carried in said PATH message, said reserving yielding a decision of either
positive, representing granting the needed network resource, or negative, representing not
granting the needed network resource;

means for forwarding said PATH message to an egress policy enforcement device if said decision is positive, said egress policy enforcement device connecting to the same network as said ingress policy enforcement device; and

means for sending a PATH_ERR message to said first party if said decision is
5 negative.

21. An apparatus for an egress policy enforcement device, said egress being defined in the direction from a sender to a receiver, said sender initiating a two-way communication, said egress policy enforcement device connecting to a network, comprising:

means for intercepting a message, said message being either a PATH message
10 or an RESV message, said PATH message carrying a resource reservation request for communication from said first party to said second party, said RESV message carrying path information and a resource reservation request for communication from said second party to said first party;

means for adding an address to said PATH message if said message is a
15 PATH message, said address identifying said egress policy enforcement device, said adding resulting in a revised PATH message;

means for determining a forwarding address for forwarding said revised PATH message;

means for forwarding said revised PATH message to said forwarding address;

20 means for reserving needed network resource if said message is an RESV message, said needed network resource being specified by the resource reservation request carried in said RESV message, said reserving yielding a decision of either positive,

representing granting the needed network resource, or negative, representing not granting the needed network resource;

means for determining a next hop address if said decision is positive, said next hop address being determined from the path information carried in said RESV message;

means for forwarding said RESV message to said next hop address; and

means for sending an RESV_ERR message to said second party if said decision is negative.

22. An apparatus for a receiver being the non-initiating party between two participants in a two-way communication, comprising:

means for intercepting a PATH message;

means for sending an RESV message to a policy enforcement device as a response to the PATH message intercepted by said intercepting, said RESV message carrying path information and a resource reservation request, said policy enforcement device connecting to a network;

means for receiving a message, said message resulting from said sending of said RESV message, said message being either a RESV_ERR message or an RESV_Confirm message;

means for entering a two-way communication session if said message is said RESV_Confirm message; and

means for aborting the initiation of said communication if said message is an RESV_ERR message.

23. A system comprising:

a sender to initiate a communication session by sending a first message, said sender receiving at least one second message, each of said at least one second message carrying a resource reservation request for the communication in a forward direction initiated from said sender, said sender responding said second message by sending a third message
5 carrying path information and a resource reservation request for the communication in a reverse direction ending at said sender, the sender entering said communication session after receiving a fourth message;

at least one ingress policy enforcement device, where ingress is defined according to said forward direction, each of said at least one ingress policy enforcement
10 device receiving both the first message sent by said sender and the second message, forwarding the first message in said forward direction, reserving needed network resource according to the resource reservation request carried in said second message before forwarding said second message, forwarding said second message in said reverse direction according to the path information carried in the second message if the requested network
15 resources are granted;

at least one egress policy enforcement device, where egress is defined according to said forward direction, each of said at least one egress policy enforcement device receiving said first, said second, and said third messages, adding its own address to the first message before forwarding the first message, adding its own address to said second message
20 before forwarding the second message according to the path information carried in the second message, reserving needed network resource according to the resource reservation request carried in said third message before forwarding the third message, forwarding the third

message according to the path information carried in the third message if the requested network resources are granted; and

at least one receiver being the non-initiating party in said communication session, each of said at least one receiver responding the sender, after receiving the first message, by sending said second message to the sender, said receiver receiving, from the sender, the third message, the first message and the third messages being received and the second message being sent by each of said at least one receiver via said at least one egress policy enforcement device connecting said receiver and a network, said receiver sending the fourth message directly to the sender before said communication session starts.

24. An apparatus for a sender initiating a two-way communication, comprising:

means for constructing a PATH message;

means for sending said PATH message to a policy enforcement device, said policy enforcement device connecting to a network;

means for receiving a first message from said policy enforcement device, said first message being an RESV+PATH message, said first message resulting from said sending of said PATH message;

means for aborting the initiating of said communication if said first message is an RESV_ERR message;

means for sending an RESV_Confirm+RESV message to said policy enforcement device if said first message is an RESV+PATH message;

means for receiving a second message from said policy enforcement device, said second message being either an RESV_ERR or an RESV_Confirm message, said second message resulting from said sending of an RESV_Confirm+RESV message; and

means for entering a two-way communication session as a response to said second message.

25. An apparatus for an ingress policy enforcement device, said ingress being defined in the direction from a sender to a receiver, said sender initiating a two-way communication, said ingress policy enforcement device connecting to a network, said apparatus comprising:

means for intercepting a message, said message being either a PATH message or an RESV+PATH message, said RESV+PATH message carrying both path information and a resource reservation request for the communication from said first party to said second party;

means for adding an address to said PATH message if said message is a PATH message, said address identifying said ingress policy enforcement device, said adding resulting in a revised PATH message;

means for determining a forwarding address for forwarding said revised PATH message;

means for forwarding said revised PATH message to said forwarding address;

means for reserving needed network resource if said message is an RESV+PATH message, said needed network resources being specified by the resource reservation request carried in said RESV+PATH message, said reserving yielding a decision of either positive, representing granting the needed network resource, or negative, representing not granting the needed network resource;

means for determining a next hop address if said decision is positive, said next hop address being determined from the path information carried in said RESV+PATH message;

means for forwarding said RESV+PATH message to said next hop address;

and

means for sending an RESV_ERR message to said second party if said decision is negative.

5 26. An apparatus for an egress policy enforcement device, said egress being defined in the direction from a sender to a receiver, said sender initiating a two-way communication, said egress policy enforcement device connecting to a network, said apparatus comprising:

10 means for intercepting a message, said message being a PATH message, an RESV+PATH message, or an RESV_Confirm+RESV message, said RESV+PATH carrying path information and a resource reservation request for the communication from said first party to said second party, said RESV_Confirm+RESV carrying path information and a resource reservation request for the communication from said second party to said first party;

15 means for adding an address to said PATH message if said message is a PATH message, said address identifying said egress policy enforcement device, said adding an address resulting in a revised PATH message;

 means for determining a hop address for forwarding said revised PATH message;

 means for forwarding said revised PATH message to said hop address;

20 means for adding said address to said RESV+PATH message if said message is an RESV+PATH message, said adding said resulting in a revised RESV+PATH message;

means for determining a next hop address for forwarding said revised RESV+PATH message, said next hop address being determined from the path information carried in said RESV+PATH message;

5 means for forwarding said revised RESV+PATH message to said next hop address;

means for reserving needed network resource if said message is an RESV_Confirm+RESV message, said needed network resource being specified by the resource reservation request carried in said RESV_Confirm+RESV message, said reserving yielding a decision of either positive, representing granting the needed network resource, or
10 negative, representing not granting the needed network resource;

means for determining a next hop address if said decision is positive, said next hop address being determined from the path information carried in said RESV_Confirm+RESV message;

15 means for forwarding said RESV_Confirm+RESV message to said next hop address; and

means for sending an RESV_ERR message to said first party if said decision is negative.

27. An apparatus for a receiver, said receiver being the non-initiating party of the two participants in a two-way communication, said apparatus comprising:

20 means for intercepting a PATH message;

means for sending an RESV+PATH message to a policy enforcement device as a response to said PATH message intercepted by said intercepting, said RESV+PATH message carrying path information and a resource reservation request for the communication

from said first party to said second party, said policy enforcement device connecting to a network;

means for receiving a message, said message being either an RESV_ERR message or an RESV_Confirm+RESV message, said message resulting from said sending of
5 an RESV+PATH message;

means for sending an RESV_Confirm message to a first party if said message is an RESV_Confirm_RESV message, said first party being the initiating party in said two-way communication; and

means for entering a two-way communication session after said sending of an
10 RESV_Confirm message.

28. The method according to claims 6, 7, 15, 16, 18, 20, 21, 23, 25, 26, wherein said reserving needed network resource includes:

requesting said needed network resource, from a resource reservation controller, said resource reservation controller connecting to the same network as said policy
15 enforcement device; and

receiving said decision from said resource reservation controller.

29. The method according to claims 6, 7, 15, 16, 18, 20, 21, 23, 25, 26, wherein said reserving needed network resource includes:

examining, by said policy enforcement device, admission control policies;
20 checking, by said policy enforcement device, the availability of network resources; and

generating said decision based on said admission control policies, said availability of network resources, and said needed network resource.

30. The system according to claims 18, 23, further comprising:

at least one resource reservation controller to reserve said needed network resource requested by said policy enforcement device, each of said at least one resource reservation controller generating a decision of either positive, representing granting the
5 needed network resource, or negative, representing not granting the needed network resource.

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